

Diet during Cardiovascular Diseases

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Abstract

Cardiovascular diseases are the 1st case of death globally. More people die annually from these diseases than from other causes. People with Cardiovascular diseases are high risk due to the presence of one or more risk factors such as HTN, DM₂, Hyperlipidemia or already established diseases. Most of these diseases are prevented by addressing behavioral risk factors such as tobacco use, unhealthy diet, obesity, physical inactivity and harmful use of alcohol. Some of functional foods like garlic, flaxseeds, soybeans, oats, and omega 3&6 fatty acids may also help to prevent the heart diseases.

Keywords: Hyperlipidemia, Trans fats, Functional Foods, Sedentary Life Style, and Diabetes Mellitus.

Introduction:

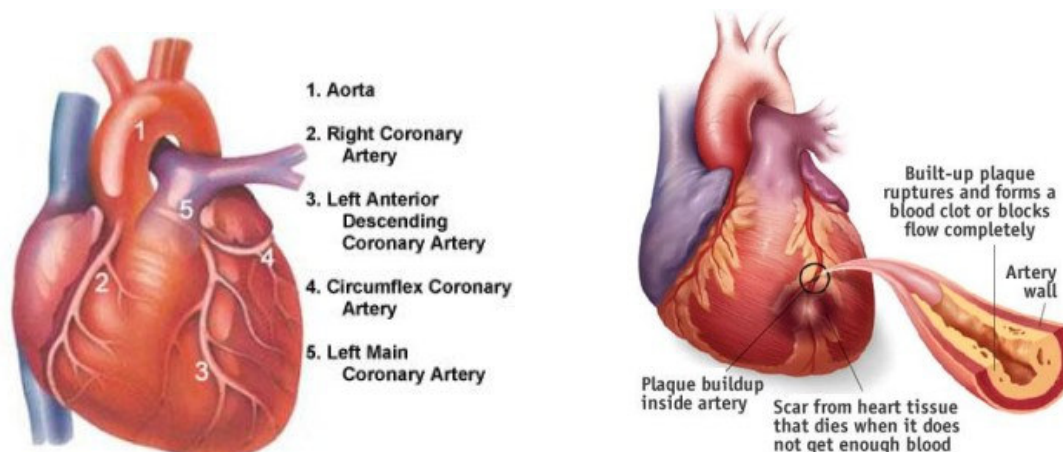
Cardiovascular disease's is a class of diseases that involves the heart or blood vessels (arteries, capillaries and veins). The function of the heart is to supply blood to the entire body as every cell or tissue in the body needs oxygen. The heart in turn as described earlier gets its nourishment through the coronary arteries. Therefore it is necessary that the coronary arteries, the heart muscles and the blood supply through several blood vessels are maintained properly throughout the entire body.

Cardiovascular refers to any diseases that affects the cardiovascular system, principally cardiac disease, vascular disease, of the brain and kidney & peripheral arterial diseases. However, as age advances or because of certain physiological and morphological changes that alters in cardiovascular functions and injures to the blood vessels as well as the coronary arteries, one tends to get diseases associated with cardiovascular system.

According to WHO an estimated 17.5 Million people died from cardiovascular diseases in 2012, representing 31% of all global deaths, an estimated 7.4 million were due to coronary heart diseases & 6.7 million deaths were due to stroke.

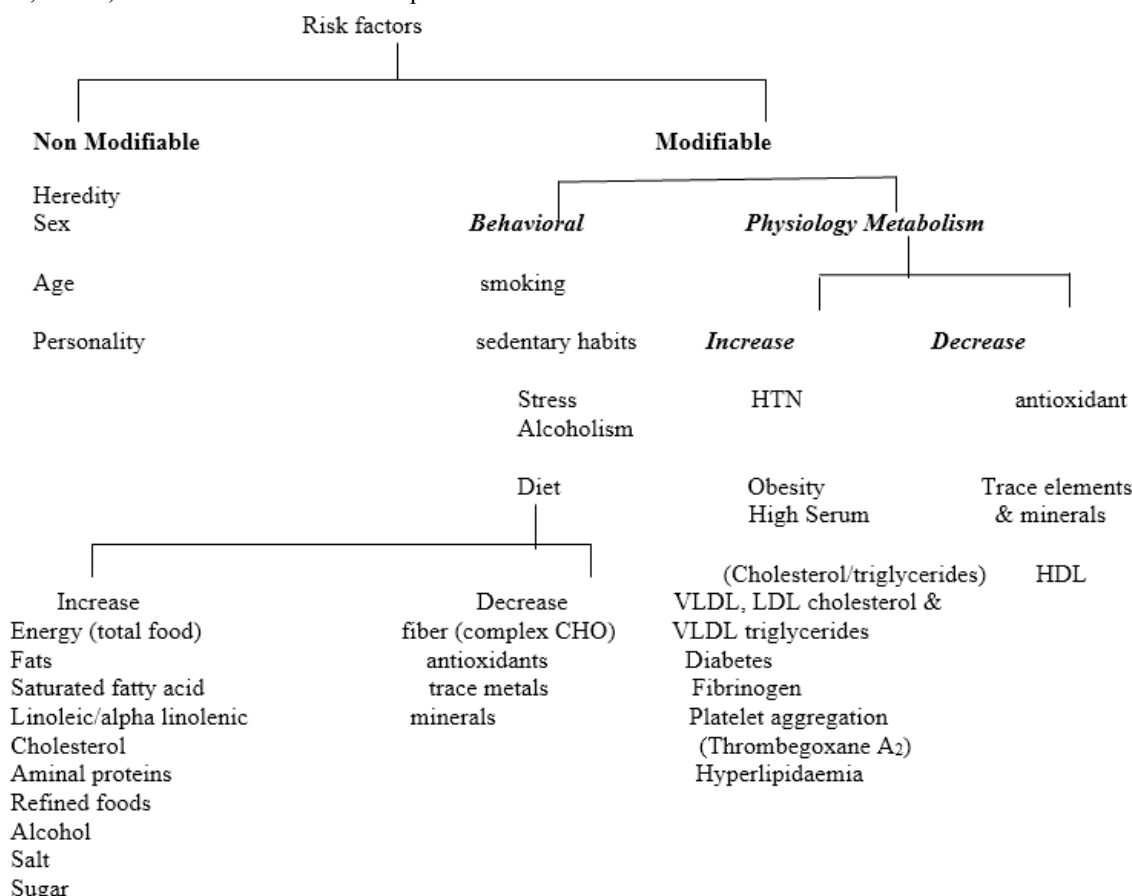
Cardiovascular diseases are a group of disorders of the heart and blood vessels and they include:

1. Coronary heart diseases or Ischemic heart diseases – disease of the blood vessels supplying the heart muscles
2. Cardiomyopathy – disease of cardiac muscle
3. Peripheral arterial disease – disease of blood vessels supplying to arms and legs
4. Cerebrovascular disease - Disease of blood vessels supplying the brain
5. Rheumatic heart disease - Damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria
6. Congenital heart disease - Malformation of heart structure existing at birth
7. Deep vein thrombosis and pulmonary embolism - Blood clots in the leg veins which can dislodge and move to the heart & lungs
8. Atherosclerosis - Soft amorphous lipid accumulation in the intima of the vessel.
9. Arteriosclerosis - Thickening / hardening of the arterial wall
10. Myocardial infarction - The major cause is coronary thrombosis
11. Infarct – An area of coagulation necrosis in a tissue due to a local deprivation of oxygen & blood resulting from an obstructive of circulation to the area
12. Hypertensive heart disease – Disease of the heart secondary to high blood pressure
13. Cardiac dysrhythmias – Abnormalities of heart rhythm
14. Inflammatory heart disease : the inflammation of the heart muscle
 - i) Endocarditis : inflammation of Endocardium
 - ii) Myocarditis : Inflammation of Myocardium
 - iii) Inflammatory Cardiomegaly.
15. Congestive heart disease – unable to supply sufficient blood for the usual metabolic needs
16. Tachycardia - An abnormally rapid heart rate.



Risk factors for coronary artery disease and related disorders general

There are numbers of underlying determinants of cardiovascular diseases or the “causes of the causes”. The most important behavioral risk factors of heart disease & stroke are unhealthy diet, physical inactivity, and tobacco use and harm full use of alcohol. The effects of behavioral risk factors may show up in individuals as raised blood pressure, raised blood glucose, raised blood lipids, and overweight and obesity. These “intermediate risks factors” can be measured in primary care facilities and indicate an increased risk of developing a heart attack, stroke, heart failure and other complications.



Clinical effects:

The principal clinical results of atherosclerotic lesions are to partial or total occlusion of the arterial lumen. The cracks and tissues developed in the lesions leads to thrombosis which is the principal cause of angina pectoris (pain in the chest provoked by exercise), myocardial infarction (death of heart muscle tissue) and sudden ischemic death (deficient blood supply).

Plaques usually develop slowly and insidiously over many years beginning from childhood. They may

progress from a fatty streak to a fibrous plaque and then to complicated plaques that is likely to lead to clinical effect.

Impairment of the heart is manifested by dyspnea on exertion, weakness and pain in the chest. In severe failure here is marked dilation of the heart. The circulation of the tissues through the kidney is so impaired that sodium and water are held in tissue spaces. Oedema fluid collects first in the serosities and with increasing failure in the abdominal and chest cavities. This is referred to as congestive heart failure.

ROLE OF FAT IN THE DEVELOPMENT OF ATHEROSCLEROSIS:

Cholesterol and triglycerides are the main forms of fat carried in the blood stream. These fats or lipids come partly from food, and partly from body's own production in the liver. Fats are not water soluble and hence cannot travel through the blood easily. With the help of lipoprotein, digested fat from the liver is carried to various parts of the body by the blood vessels. The cholesterol returns to liver and repeats its job.

The liver places cholesterol into packages called lipoproteins, made from lipids and protein. There are mainly four kinds of lipoprotein packages namely chylomicrons, VLDL (very low density lipoprotein), LDL (low density lipoprotein) and HDL (high density lipoprotein). High density lipoprotein has more protein content.

Chylomicrons carry triglycerides whose fatty acids contain more than 10 to 12 carbon atoms, monoglycerides, glycerol and small amounts of cholesterol and phospholipids.

VLDL also transport triglycerides but mainly endogenous triglycerides formed in the liver. The VLDL travels through the blood vessels to unload it throughout the body. The 'empty' VLDL becomes LDL.

LDL is the main carrier of cholesterol. Some LDL pieces get stuck to the blood vessel walls, narrowing the same. High LDL decreases Endothelium Derived Relaxing Factor and blood vessel becomes narrow and cannot dilate. LDL is called 'bad' cholesterol because it causes atherosclerosis.

HDL plays a role in the reverse transport of cholesterol from tissues throughout the body back to the liver for conversion to bile acids or excretion as biliary cholesterol. HDL is called good cholesterol.

HDL particles enriched in free cholesterol can then be modified by the enzyme lecithin cholesterol acyl transferase, which esterifies the free cholesterol with linoleate from lecithin. The cholesterol ester moves from the surface of the lipoprotein to the core (because of its hydrophobicity), allowing more free cholesterol to be adsorbed onto the surface and resulting in particle enlargement. As HDLs become enriched in cholesterol ester, they become significant vehicles for delivering esters to the liver for conversion to bile acids or excretion as biliary cholesterol.

The second potential anti atherogenic activity of HDL relates to its role as an antioxidant or anti aggregant in the vessel wall.

If too much of fat is consumed, the liver makes extra VLDL to carry the fat. More LDL pieces get stuck if there is not enough HDL to rescue them all. The blood vessel may become blocked. If this happens to a blood vessel in the heart, a heart attack may result. Genetically, Indians have a low level of HDL.

Coronary heart disease is a process, not a single event. The sequence of development of atheroma is given in the schematic figure.

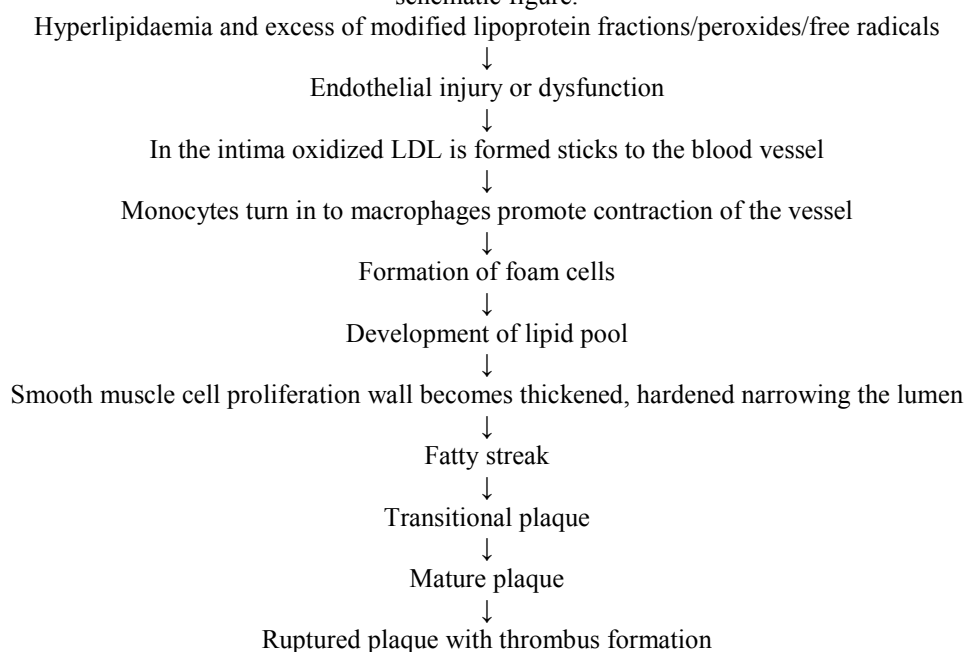
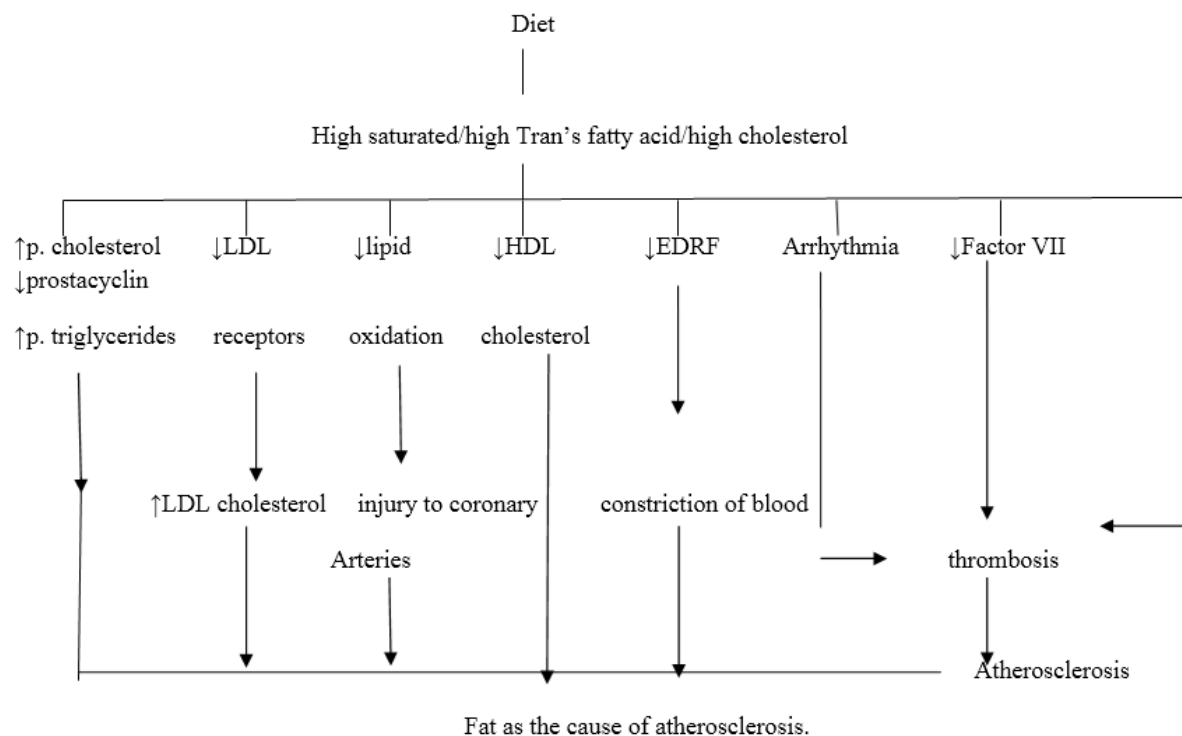


Figure: Development of atheroma



Saturated fatty acids

Saturated fatty acids raise the level of LDL and total blood cholesterol level. Both of these effects increase the risk of CHD. The activity of LDL receptor — its ability to mediate the entry of LDL— appears to be suppressed by saturated fatty acids. When LDL receptor activity decreases, LDL catabolism decreases and blood levels of LDL increase.

Individual saturated fatty acids differ in their ability to change blood LDL— cholesterol levels. Palmitic, myristic and to a lesser degree lauric acids increase the LDL- cholesterol level. In contrast stearic acid and medium to short-chain fatty acids do not.

Tran's fatty acids

Tran's fatty acids raise LDL cholesterol to the same extent as myristic acid in addition lower HDL cholesterol. Thus Tran's fatty acids turning out to be even more atherogenic than myristic acid. HDL cholesterol. Thus Trans fatty acids turning out to be even more atherogenic than myristic acid. Further Tran's fatty acids have been found to raise lipoprotein (a) levels, thus raising the risk of CHD.

Tran's fatty acids in the diet come from two main sources.

- Bacterial fermentation: In the gut of ruminants trans fatty acids are produced. Meat and dairy products contain Tran's fatty acids.
- Hydrogenated fats: Hydrogenation of vegetable oils alter the geometric structure of the polyunsaturated fatty acids from normal 'cis' to 'trans' forms. Only cis forms can serve as essential fatty acids to be incorporated in cell structure. Depending on the degree of hydrogenation, trans-fats in food products contain anywhere from 5 per cent to as high as 40 per cent.

Summary of Fat as the Cause of Atherosclerosis

1. High intake of saturated fatty acid can lead to
 - (a) ↑ Plasma cholesterol → ↑ Atheroma formation.
 - (b) ↓ LDL receptors → ↑ LDL cholesterol
 - (c) Arrhythmia → Thrombosis.
 - (d) ↑ Lipid oxidation → Injury to coronary arteries.
 - (e) ↑ Factor VII level → Thrombosis.
 - (f) ↓ Antiaggregatory prostacyclin.
 - (g) ↓ HDL cholesterol.
 - (h) ↑ Plasma triglycerides.
2. High cholesterol can lead to

- (a) ↑ plasma cholesterol
- (b) ↑ LDL synthesis
- (c) ↓ LDL catabolism by cells.
- 3. Low ω (omega) – 3 Fatty acids intake
 - (a) Arrhythmia → Thrombosis
 - (b) ↑ Fibrinogen → Thrombosis
→ ↑ Fibrous plaque.
 - (c) ↑ Platelet aggregation → Thrombosis.
 - (d) ↑ Lipoprotein (a) - ↑ Fibrous plaque
 - (e) ↑ Inflammation – Injury to coronary arteries.
 - (f) ↑ B.P. → Injury to coronary arteries.

Figure summarizes fat as the cause of atherosclerosis.

The role of Non-Fat factors in Atherosclerosis

Nutrients other than fat play an important role in preventing or promoting atherosclerosis by changing blood levels of cholesterol, high density lipo, protein (HDL) cholesterol, and triglycerides.

Calcium: Large amounts of calcium have been shown to lower our cholesterol and triglyceride levels. Failure to take in the 800 mg/ day of calcium is resulting to cardiovascular diseases in women.

Carbohydrate: The body tends to manufacture triglycerides when sucrose is consumed in large amounts. Although the evidence is not conclusive, this & other research data tend to suggest that a diet rich in simple carbohydrates may well increase the risk in susceptible individuals of forming atherosclerotic plaque.

Chromium: Cholesterol levels drops while HDL cholesterol levels rise when the diet is supplemented with chromium. Thus, chromium may have a protective role against plaque formation.

Copper: One human experiment involving a copper deficiency resulted in higher serum cholesterol level. Thus also occurred in several experiments with rats. This nutrient may protect against atherosclerosis. The RDA for copper is 1.5 to 3 mg/day.

Fiber: Cardiovascular diseases is less common in populations that have high fiber diets than it is in populations in developed countries where a more refined lower fiber diet is consumed. Researches continue to determine the most effective types and amounts of dietary fiber to use in reducing the risk of the disease.

Iron: Severe Deficiency (Anemia) increases blood lipid levels, but moderate anemia may actually lower cholesterol levels. This is an important nutrient to watch, because iron- deficiency anemia strikes most often during early infancy and childhood. When protective measures should begin.

Zinc: In experiments a zinc deficiency lowers blood cholesterol levels. Very high intake apparently reduces HDL levels, suggest that large amount of zinc may increase the risk of disease.

Symptoms of Cardiovascular disease's:

Often, there are no symptoms of the underlying disease of the blood vessels. A heart attack or stroke may be the first warning of underlying diseases. Symptoms of a heart attack include

- I. Pain or discomfort in the centre of the chest.
- II. Pain or discomfort in the arms, the left shoulder, elbows, jaw or back.

In addition the person may experience difficulty in breathing or shortness of breath, feeling sick or vomiting, feeling light – headed or faint.

Dietary treatment:

Principle Of Diet:

Low caloric, low fat (↓saturated fat) low cholesterol, high PUFA(n-6 &n-3) low carbohydrates, normal protein, mineral & vitamins, high fiber diet is recommended.

Total Energy:

The total calories should be restricted so as to reduce the weight to the expected normal for the height, age and sex.

Mild degree of weight loss for the cardiac patient of normal weight is recommended. Usually a 1000 to 1200 k.caldiet is suitable for an obsess patient in bed.

Low of weight by the obese leads to a considerable reduces in the work of the heart because the basal metabolism is at a lower level.

Fat:

The first step involved restriction of fats to no more than 20% of the calories consumed.

Polyunsaturated fatty acids like omega-6 linoleic acids. Lower both total cholesterol & LDL cholesterol levels. However, very high levels of linoleic acid also lower HDL-cholesterol levels.

Omega 3, lower LDL- cholesterol & total serum cholesterol levels but not the HDL cholesterol level.

Cholesterol:

Liver synthesis as much as 2g of cholesterol per day. Cholesterol level in the diet should not vegetable oils diminish the plasma cholesterol not only due to polyunsaturated fatty acids but also because the plant sterols

inhibits cholesterol absorption.

“Mustard oil & soyabean oil “are rich in n-3 alpha linolenic acid. Safflower oil & corn oil are rich in n-6 linoleic acid.

Carbohydrates:

Total calories are restricted, CHO intake would be reduced. By reducing sugar intake, serum triglycerides decrease.

Protein, Vitamin & Mineral: Normal allowances are recommended.

Sodium: it is restricted when there is hypertension. Usually a restricted of Na of 1600 to 2300 mg is satisfactory in patients with CHO.

Fluids:

The restriction of fluids is not required as long as “Na” is not restricted.

Low Glycemic Foods:

Low glycemic foods lower post prandial fatty acids concentration which may be associated with increased glucose uptake by muscle, reduced VLDL synthesis & in turn reduce LDL & increase HDL low glycemic diets may reduce plasma fatty acids & may suppress production of release of signaling hormones from adipose tissue in turn tending to reverse dyslipidaemia & insulin resistance

High Fiber:

High fiber in the diet reduce cholesterol peptic (apple, guava) lowers the level of serum cholesterol & enhances the excretion of fecal steroids. It has no effect on serum triglycerides and HDL cholesterol.

Studies show that blood pressure can be reduced by using fibre rich diets. Dietary fibres also reduce “serum fibrinogen” levels. Which in turn lowers the risk of blood clot formation & myocardial infarction?

Foods that have hypocholesterolemic effects like soya bean, fenugreek, garlic, onion & turmeric should be included in the diet.

Dietary Guidelines

- Patient should maintain the body weight slightly lower than the standard weight. Accordingly total calories should be restricted. Calorie intake and physical activity should be balanced to maintain a healthy body weight.
- The patient should know the energy requirement to maintain healthy body weight. He should know the energy content of foods he consumes.
- The patient should eat variety of foods which are low in fat, saturated fat and cholesterol. Trans fat should be avoided. Intake of bakery products should be limited. Soft margarines have less Trans fatty acids than stick margarines.
- Vegetable oils rich in poly unsaturated fatty acids like sunflower safflower oil should be included in the suggested combinations as given in the following table. Solid fats should be avoided. Olive oil rich in monounsaturated fatty acid can be included.
- Small quantities of walnuts and almonds can be consumed to bring down the cholesterol levels. High amounts of nuts and oil seeds increase the calories and fat content in the diet.
- Coconut should be avoided in the diet as it contains high amount of saturated fatty acids and it is a concentrated source of energy.
- Egg yolk contains cholesterol. Hence eggs should be restricted to 2-3 eggs/week. Cholesterol containing foods should be limited in the diet.
- Animal foods like meat and pork which contain high amount of saturated fat should be avoided. Chicken can be taken instead of red meat. Shrimps and crabs have less amount of fat and can be included in the diet. All sea foods are rich in sodium. Hence hypertensive patients should avoid these foods.
- Inclusion of fish in the diet is beneficial as they contain ω -3 fatty acids.
- Patient should take skim- milk or low fat milk.
- Fat substitutes can be used to decrease the fat content of the diet.
- Boiling, steaming, grilling and baking without fat are preferable method for cooking.
- Five servings of fruits and vegetables should be included in the diet not only to meet the nutritional requirement but also to meet antioxidants and fiber. Fruits and vegetables can be taken as snacks.
- Foods rich in antioxidants containing carotenoids and vitamin-E protect from cardiovascular diseases. Whole grain cereals, fruits and vegetables increase the antioxidant content of the diet.
- The diet should be rich in fiber by including foods like raw salads, fruits, green leafy vegetables and whole grains.
- Constipation should be prevented by including plenty of water and fiber in the diet.
- The patient should avoid taking preserved foods, especially high energy syrups, sauces and gravies.
- Foods giving only empty calories like carbohydrate beverages, alcohol, sugar and sago are totally

avoided.

- Concentrated foods like sweets, chocolates, cakes, pastries, ice creams and fried foods should be restricted or preferably avoided.
- To restrict sugar intake, artificial sweeteners can be included occasionally in the diet.
- Intake of beverages and foods with added sugars to be minimized.
- Coffee and tea can be taken in moderation. Excess amount of caffeine increases the heart rate.
- Foods that have hypocholesterolemic effects like soya bean, fenugreek, garlic, onion, flax, oats and turmeric should be included in the diet.
- If the patient is suffering from hypertension, sodium should be restricted.
- Heavy meals should be avoided. Small and frequent meals are preferred.
- Taking outside meals are to be avoided as they are mostly high in fat or calories.
- Elevated C- reactive protein levels, a marker of systemic inflammation are a risk factor for cardiovascular disease and diabetes. Multivitamin supplementation (α - tocopherol, B₆ and Vitamin C) reduce C-reactive protein levels.

These dietary guidelines are not presented as diet plan, per se, but as something that can be thought of as a life style prescription to promote cardiovascular health.

Along with dietary and life modifications, exercise and proper medication can reduce the risk of atherosclerosis though one cannot substitute the other. Lipid lowering agents such as statins, HMG CoA reductase inhibitors, fibrates, and niacinamide and fish oils are not substitute for diet and exercise.

GENERAL INSTRUCTIONS FOR HEALTHY HEART

The heart is considered to be in failure when it is unable to supply sufficient blood for the usual metabolic needs of the body.

The higher risk factors are serum cholesterol over 240mg/100ml and diastolic blood pressure over 105mmhg. And cigarette smoking, alcohol, diabetes, obesity, stress and commonly dietary habits like high intake of fats.

Foods included

Wheat, wheat semolina, jowar, ragi, bajra. Brown bread, rice flakes, puffed rice.

All Dhals and pulses, sprouted legumes.

Milk and curd without cream

Fish oil 6gms/day

Add garlic, onions, soyabeans, walnuts, almonds in the diet.

Lean meat' skin less chicken, white fishes, egg white

Diluted butter milk, lemon juice, soups, plain soda

Spinach, amaranth, coriander leaves, curry leaves, mint, fenugreek leaves, gogru, drumstick leaves

Bitter gourd, bottle gourd, cauliflower, cluster beans, french beans, cucumber, ladies finger, brinjal, ridge gourd, snake gourd, tomato, capsicum, kofta, cabbage, drumsticks.

Foods to be avoided

All sweets, sugar, honey, jaggery, glucose, jam, sugar cane juice, coconut water.

Bakery products, like cakes, cream biscuits, chocolates, all maida products and all refined products.

Ghee, dalda, butter, cream, palm oil, coconut oil.

Fried foods and oily preparations.

Fatty meat cuts, organ meats like liver, kidney, brain, heart, pork, egg yolk.

Cashew nuts, ground nuts, sesame seeds, coconut, dates, raisins etc.

Potato, sweet potato, colocasia, tapioca, jack fruit seeds, green plantain, beetroot, yam.

Alcoholic beverages, soft drinks.

Pickles, bouillon and canned fruits.

Vermicelli, noodles, white bread

Some tips to be followed:

Use fresh fruits and vegetables(salads) in the diet.

Use refined ground nut oil, mustard oil, safflower oil, sunflower oil, olive oil, flaxseeds oil, rice bran oil, soya oil-5 to 6 tsp/day.

Take meals and medicines on time

Sample Diet for Heart Patients

Early morning (6.am)	green tea/ tea/ coffee/ herbal tea – 1 cups
Break fast (8.am)	idly 3 / dosa 2 / thin chapathi 2/ oats 2 tbps / brown bread 2 slices (dry toast) wheat upma 1 ½ cup chutney (curry leaves powder/ mint or coriander & vegetable).
Mid morning 10.30 am	butter milk- 150 ml / fruit 60 to 80gms.
After noon 12 pm	brown rice 1 ½ katori or pulka/ roti 3(small) Dhal with green 1cup / samber 60 ml + vegetable curry 2 cups, Egg white.
Mid after noon 3 pm	veg salad 1 cup/ sprouted legumes 1cup
Snacks 4.30pm	Mari biscuits 3 / rice flaks 25 gms/ oats 25 gms / Ragi java (2 tbps ragi with butter milk 150 ml/ brown bread 3 slices / soup 150 ml + tea/ coffee / green tea 1 cup
Dinner 8. pm	Roti or Pulka 3 + Leguminous vegetable curry 1 ½ cup + Curd rice 50 gms + Dhal with green 1 cup
Bed time 10.pm	low fat milk 75ml

Conclusion

Risk of coronary disease can be reduced by consuming a balanced diet optimized for calories, quantity and quality of fats (saturated vs polyunsaturated) cholesterol, anti oxidant vitamins, minerals, fiber & salt. Diets high in complex CHO derived from natural foods such as whole cereals and millets, legumes & pulses with optimal amounts of milk & visible fat (vegetableoils)& liberal intakes of vegetables & fruits are recommended. Foods which are refined (processed), calorie dense, deep fried and fast foods should be avoided.

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